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Relationship of Surrounding Geology to Well Recovery Properties for Selected Cedarville University Water Supply Wells

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Abstract

This study was conducted to ascertain the relationship between geology and the recovery rate of three selected Cedarville University water supply wells. An analysis of the rate of recovery of the wells in the well field will allow for a better understanding of the wells' overall performance. It will add to the existing data base of well information for Cedarville University. The three selected wells were individually pumped down and then water level measurements were taken in order to determine the rate of recovery. The collected data was analyzed and compared to the drillers' well logs and tests that were conducted at the time the wells were drilled. Analysis of the data was conducted with the use of an illustrator program in conjunction with the information from the drillers' logs and the recovery data collected. I have created a visual representation of the connection between the recovery and the geology. Three illustrations have been created using this method, providing a correlation assessment for all three wells. The drillers' logs were provided by the university. In addition, other published geologic information for the area was utilized and provided further information as to the relationship of the surrounding geology and the recovery rate.

Goals

This project has provided an understanding of how the geologic conditions affect a water well's recovery. Well records, maps, and published reports indicate variation in geologic conditions for the study area. The geologic conditions that I have examined for the area immediately surrounding the wells include: bedrock lithology, glacial drift characteristics, and bedrock topography. The goal was to be able to interpret how these differences affect well recovery.

Procedure

A recovery test was performed on wells #9, #10, and #11. The three wells were chosen based on 3 criteria: accessibility, lithologies penetrated, similarities in casing and pump size, and completeness of well records. Each well was examined in the same manner, all 3 were analyzed using a recovery test. Each well was drawn down and allowed to recover to its pre-pumped levels. Each well was individually tested by measuring the rate of recovery. The date, time, elapsed time during recovery, water level pumping rate, and drawdown were recorded on-site during the test. An example of the data sheet is shown below. The rate of recovery at specific time intervals was measured using an electronic water level measuring device. Specifically, a Solinst Water Level Meter Model 102 which has 200ft of cable was used. The flow meter is measured in tenths of feet. The meter was lowered into the well and when the end of the meter cable came in contact with water the device made a buzzing sound. Before the pump-down test began, the static water level was measured. Recordings were taken at predetermined increments that increased as the test progressed, we started at an interval of 30 seconds and moved to intervals of 1, 2, 5, 10, and 30 minutes. The recovery test was terminated when the water level reached 95% of the pre-pumped static water level.

Date	Time	Elapsed time during recovery (min)	Pumping rate (gal/min)	Water Level (ft)	Drawdown (water level – static level) (ft)

Analysis

The data collected during recovery tests was compared to the lithologies listed in the original drillers' logs. This information was compiled and examined using the data from both sources to create the 3 charts. Some of the data shown on the plots is a little skewed, this is do to cascading water that made it difficult to tell whether or not the water level meter was completely immersed in water or in a section of cascading water. The amount of cascading exceeded expectations. This cascading water was only encountered when the water level fell below the casing.

Conclusions

The wells with the least amount of glacial drift recovered faster, #10&11.

Suggestions for Further Analysis

In future recovery tests a measuring tube should be used to prevent the misreading of the water level due to cascading water.

Acknowledgements

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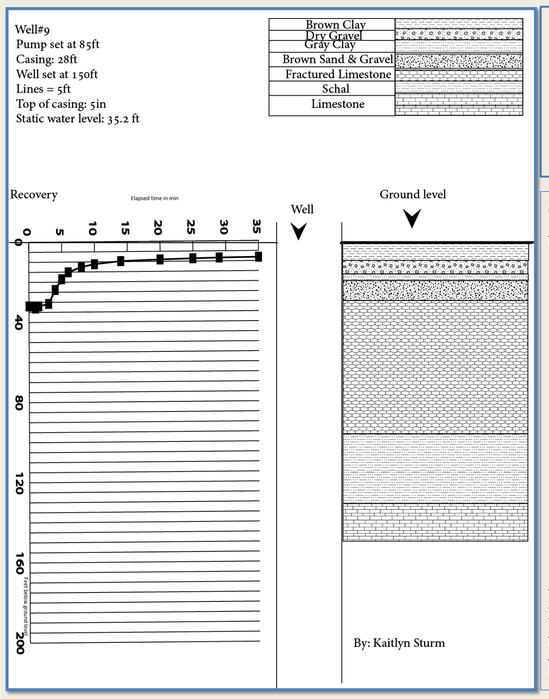

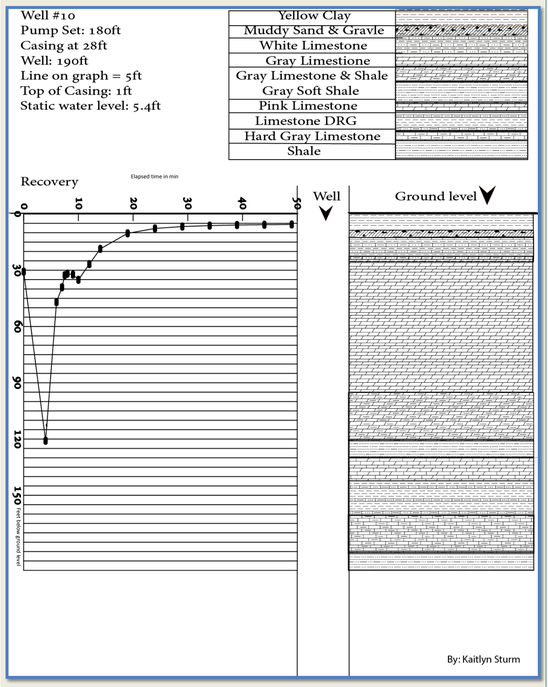

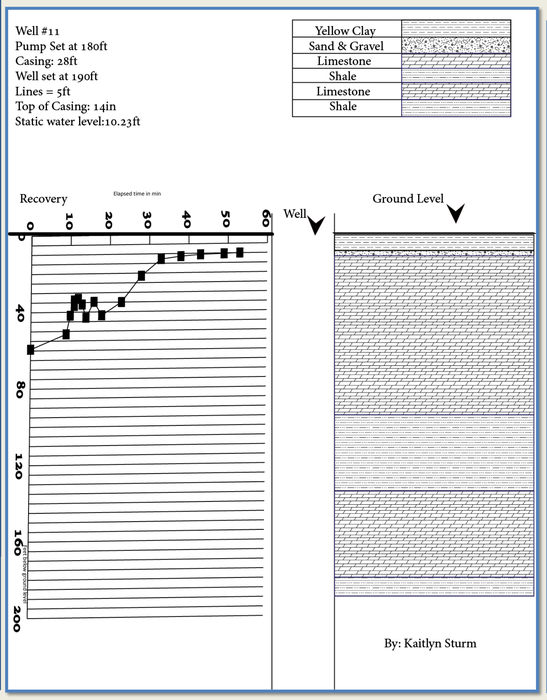

Calculated Rate of Recovery

Well #9→0.97 ft. per min
Well #10→ 1.22 ft. per min
Well #11→ 1.20 ft. per min

Comprehensive recovery data was not listed in the drillers log for well #9.

Well #9's lithologies:
- Brown Clay 0-10ft
- Dry Gravel 10-17ft
- Gray Clay 17-20ft
- Brown sand and Gravel 20-30ft
- Fractured Limestone 30-91ft
- Shale 91-132ft
- Limestone 132-150ft

According to the collected data from the well recovery test, the rate of recovery is related to the amount of glacial drift, or depth to bedrock.

According to the drillers log for well 10, the upper limestone/dolomite extends to a depth of 121 feet. While, the Lockport limestone/dolomite extends to a depth of 110feet. The shale is present from 121 feet to 130 feet; the Brassfield was encountered at this point. The lower limestone unit extends to a depth of 180 feet, where the shale is encountered. The original pumping test was conducted on September 14, 1994. The static water level noted before the test was 12 feet below the top of the casing.

Well #10's lithologies:
- Yellow Clay 0-5ft
- Yellow Clay 5-9ft
- Muddy Sand and Gravel 9-12ft
- White Limestone 12-26ft
- Gray Limestone 26-95ft
- Gray Limestone and Shale 95-121ft
- Gray Soft Shale 121-130ft
- Pink Limestone 130-143ft
- Limestone DRG 143-161ft
- Hard Gray Limestone 161-180ft
- Shale 180-190ft

According to the collected data from the well recovery test, the rate of recovery is related to the amount of glacial drift, or depth to bedrock. The cascading water was encountered at 28ft.

According to the drillers log for well 11 the Lockport limestone/dolomite was present from 11 ½ feet to 121 feet. The shale extended to a depth of 130 feet at that point the Brassfield was penetrated. The Brassfield was present from 130 feet to 180 feet. The well was terminated at 190 feet after drilling into the lower shale unit. During the initial pumping test, the pump was placed in Well #11 and a 24 hour test was started on Oct 19 1994. The static water level noted before the test was 17 feet below the casing. The pumping level stabilized at about 170 feet.

Well #11's lithologies:
- Yellow Clay 0-9ft
- Sand and Gravel 9-12ft
- Limestone 12-27ft
- Limestone 27-95ft
- Limestone with shale 95-118ft
- Shale 118-130ft
- Limestone 130-180ft
- Shale 180-190ft

According to the collected data from the well recovery test, the rate of recovery is related to the amount of glacial drift, or depth to bedrock. Cascading water was encountered when the water level meter was below the casing.